

IPv6 Troubleshooting for Helpdesks

Using test-ipv6.com

Draft v.00

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1. What is a BCOP

A current document describing how to best achieve an operational practice agreed by subject matter experts and periodically reviewed by community.

2. Summary (Appeal)

This BCOP provides a basic and generic foundation for any user-centric helpdesk that deals with IPv6 customer connectivity. The focus is on techniques and solutions for the most common IPv6 user connectivity issues. While these issues are often found in residential ISP networks, enterprise IT helpdesks and other front line support personnel should be well served by this BCOP.

3. Background / History

Many network operators who deal directly with end users are concerned about deploying IPv6. One complaint often sounds something like: "We deployed IPv6 in our network and all our services, but will not roll it out to our residential customers, because our helpdesk knows nothing about it and we can't do it."

The issue would be solved in many cases, if the operations folk would have a very simple and generic document (template), where the lowest common denominator of procedures and troubleshooting tips would be documented - so they would just add their specifics and hand over to helpdesk manager, saying "Hey, we implemented IPv6 and here are a few basic things that your people need to understand and know".

While this document cannot encompass all possible problems, it should provide a solid first step for front-line support personnel.

4. Using This Document - Note for Helpdesk Managers

This document is intended as a template that can be altered and supplemented with all individual company specifics needed so each company builds the most suitable policy and procedures to follow when the IPv6 issue is detected.

This document relies heavily on the site <http://isp.test-ipv6.com>, written by Jason Fesler, in support of this document. ISPs should strongly consider running a local mirror, so they can provide their own support. In those cases, replace the text "isp.test-ipv6.com" with "test-ipv6.example.net/isp" or whatever your site is called.

Several cases rely on checking setting on the home router. The helpdesk technician will need to be familiar with the router configuration, or refer to vendor documentation. Also, the technician may need to determine whether IPv6 address space is allocated from the company; supply the technician with a list of valid prefixes used. Based on the helpdesk structure, the instruction to escalate may occur at different times.

5. IPv6 Troubleshooting

Most connectivity problems are NOT IPv6 related at all.
Calls related to IPv6 are very rare.

Have user visit <http://isp.test-ipv6.com>

If the user cannot reach the site at all, follow standard procedures and scripts to determine whether there's a physical connectivity problem or other standard complication. If the site is available to the user, continue using this document.

If IPv4 is working but the page is unavailable, check DNS. In the user's device's network settings, check DNS/name servers. If the servers there have IPv6 addresses, check connectivity to those servers:

- Windows: Open a cmd window and run “ping [address]”
- MacOS: Open a terminal window and run “ping6 [address]”

If they are not reachable, configure different servers.

isp.test-ipv6.com reports test results in a very compact way:

Help desk code: xx

Summary

Status of IPv4, slow/timeout warnings, ASN, and ISP name

Status of IPv6, slow/timeout warnings, ASN, and ISP name

(Major warnings, such as MTU)

Status of reachability to “other sites”

IPv4 address

IPv6 address

Ask the user to read the “help desk code” near the top (in **Blue**). Then, find that code in **blue** below to identify the problem and troubleshoot it.

The list of “help desk codes” follow (from http://test-ipv6.com/faq_helpdesk.html).

- | | |
|-----|-----------------------------|
| 112 | IPv4, plus Broken IPv6 |
| 4 | IPv4 only |
| 4t | IPv4 plus Teredo |
| 46 | IPv4 + IPv6 |
| 46t | Dual Stack, Possible Tunnel |
| 624 | 6to4 |
| 64 | NAT64 |
| 64t | NAT64, Possible Tunnel |
| 6 | IPv6 only. |

112 - IPv4, plus Broken IPv6

Help desk code: 112

IPv4, plus Broken IPv6

IPv4: Good, AS65536, CableCo
IPv6: broken

IPv4 address: 192.0.2.1

Interpretation: IPv6 network connectivity somewhere between the user and the website is broken. IPv6 connections are timing out instead of succeeding (or failing fast to IPv4). The user experience visiting major web sites may be suffering, and some applications completely failing.

Assumption: User has already power cycled home router, modem, and device, as part of your standard troubleshooting procedure.

Action:

1. Determine whether IPv6 is offered to this customer, based on company documentation.
2. Confirm whether the user's equipment (modem, router) supports IPv6, based on company list of approved devices. Some retail equipment may also support IPv6. A firmware upgrade may be required; a reboot may trigger a firmware upgrade, or your company may have documented processes to upgrade firmware.

3: Identify the customer's IP address.

- Windows 8.1:
 - Press (windows key) to go to the Start Screen
 - Type "cmd" to search for the command prompt
 - Click "Command Prompt" to open the application
 - In the command prompt window, type "ipconfig" and press enter
 - When done reviewing the data, type "exit" and press enter
- Windows 7, Windows Vista:
 - Click the Start button
 - Type "cmd" to search for the command prompt
 - Click "cmd.exe" to open the application
 - In the command prompt window, type "ipconfig" and press enter
 - When done reviewing the data, type "exit" and press enter
- Windows XP
 - Click the Start button
 - Click the "run" option
 - Type "cmd" and hit enter
 - In the command prompt window, type "ipconfig /all" and press enter
 - When done reviewing the data, type "exit" and press enter
- Apple OS X
 - (from <https://kb.wisc.edu/helpdesk/page.php?id=9257>)

- Open Terminal
 - Click the Spotlight search icon in the upper right corner
 - Type “Terminal”
 - Click the Terminal icon from the search results
- Type “ifconfig | grep inet6” to get the list of IPv6 addresses
- When done, either type “exit” or click the red button on the terminal window

4. Check the IPv6 addresses:

Ignore the addresses that start with “fe80:” or “2001:0:”, and address “::1”. Identify any remaining address(es); and use the following table:

All addresses start with [<i>ISP allocated IPv6 space</i>]	<p>Network problem.</p> <p>If your organization dynamically assigns IP addresses, then escalate.</p> <p>If your organization statically assigns IP addresses, verify that the customer has the proper details per company documentation for WAN, LAN, and default gateway. If the customer confirms that the details are entered as assigned, then escalate.</p>
All addresses start with “fc” or “fd”	<p>“check the router”.</p> <p>(A future version of this document will offer more ULA advice, as we gain more experience)</p>
All addresses start with “2002:”	6to4; disable 6to4 using http://support.microsoft.com/kb/929852 (for example, Microsoft Fix it 50412)
All addresses start with “2001:0:”	Teredo; disable using http://support.microsoft.com/kb/929852 (for example, Microsoft Fix it 50412)
One or more addresses start with 2001:db8: or 2005:123:456:789:	This address is a known invalid address. Encourage the customer to call their router vendor for support.

Any other single address	Either the host is manually misconfigured; or another device on the customer's network is offering broken IPv6 services (and possibly misconfigured). They will need to possibly seek on-site help.
Multiple addresses: At least one matches our address (...)	Host selection problem? Network problem?
Multiple addresses: If none match our address (...); but at least one address starts with "2001:0:" or "2002:"	Windows: Disable tunnel interfaces using http://support.microsoft.com/kb/929852 (for example, Microsoft Fix it 50412). If only one address remains, test with test-ipv6.com, and consult this table if problems persist.
Still here?	Escalate

If there is a home router, first determine if IPv6 is configured on the WAN, if it is not, there should be no IPv6 configured on the LAN.

- a. Check the configuration of the home router: if an IPv6 address is visible on the WAN port (e.g., 2001:db8:1234:abcd::83/64), but not on the LAN port, troubleshoot with vendor documentation.
 - b. Check the LAN settings on the home router (refer to vendor documentation). If it has not given out any IPv6 addresses, troubleshoot with vendor documentation.
3. If the home router has a working WAN connection make sure that the automatic provisioning on the LAN is correct. Ensure that an appropriate IPv6 prefix was delegated to the home router and assigned to LAN interface(s).
- a. Check the configuration of the device
 - b. Check the configuration of Router Advertisements on the home router
 - c. Check the configuration of the DHCPv6 server on the home router
 - d. Check the device for the proper provisioned prefix
 - e. Check the device for a matching (set of) LAN prefix(es)
4. If the home router is providing the correct information to the LAN, check if the user device is overriding those settings.
- a. Check if the user device has static address settings that don't correspond to the settings on the home router

5. Have the user re-run the ISP.Test-IPv6 test and provide new results.
 - a. If not fixed, start the troubleshooting process again
 - b. Follow your escalation procedure when needed

Note: Enabling IPv6 WAN provisioning often requires a router/modem reboot.

4 - IPv4 only

Example results:

Help desk code: 4
IPv4 only

IPv4: Good, AS65536, CableCo

IPv4 address: 192.0.2.1

Interpretation: User's issue is not caused by IPv6, as there is no IPv6 configured. If Teredo was found and mentioned, we determined it is "safe" (and not actively being used for connections to web sites by DNS name).

Action:

1. Determine whether IPv6 is available in this area, based on company documentation.
2. Confirm whether the user's equipment (modem, router) support IPv6, based on company list of approved devices. Some retail equipment may also support IPv6. A firmware upgrade may be required; a reboot may trigger a firmware upgrade, or your company may have documented processes to upgrade firmware.
3. If the company has processes to configure IPv6 manually, do so and test again. Most residential ISPs automatically configure IPv6 where available, so manual configuration is not possible.
4. Configure IPv6 on the user's device, using vendor documentation.

4t - IPv4 plus Teredo

Example results:

Help desk code: 4t
IPv4 plus Teredo

IPv4: Good, AS65536, CableCo
IPv6: Good, Teredo, Preferred
OtherSites: 40/40 good

IPv4 address: 192.0.2.1
IPv6 address: 2001:db8::1

Interpretation: Teredo was used to provide an IPv6 address; and the host was configured to actively take advantage of this service. Any web site that has an IPv6 presence, will be reached using Teredo instead of native IPv4. Modern operating systems do not prefer these kinds of tunnels by default. Be aware that the user might have a very old operating system or a non-default configuration.

Action: Have the user disable any automatic tunneling mechanisms that are active. Teredo is a protocol that runs on the PC and tries to get IPv6 traffic through a NAT device or firewall.

Disable tunnel interfaces using <http://support.microsoft.com/kb/929852> (for example, Microsoft Fix it 50412).

46 - IPv4 + IPv6

Example results:

Help desk code: 46
IPv4 + IPv6

IPv4: Good, AS65536, CableCo
IPv6: Good, AS65536, CableCo
OtherSites: 40/40 good

IPv4 address: 192.0.2.1
IPv6 address: 2001:db8::1

Interpretation: This is an example of a healthy IPv4 + IPv6 configuration. Both IPv4 and IPv6 are working, at least to this web site.

Action: None - unless the “OtherSites” test reports any problems. If problems are reported,

investigate possible IPv6 routing or peering issues. If the company had a dual-stack speed test server, try that to identify performance issues.

46t - Dual Stack, Possible Tunnel

Example results:

Help desk code: 46t

IPv4 + IPv6

IPv4: Good, AS65536, CableCo

IPv6: Good, AS64511, AnotherCo

OtherSites: 40/40 good

IPv4 address: 192.0.2.1

IPv6 address: 2001:db8::1

Interpretation: This is an example of a healthy IPv4 + IPv6 configuration. The IPv6 connectivity appears to be announced by a different entity (or at least, a different BGP ASN) than IPv4.

Action: Ask the user to read the IPv4 and IPv6 lines; ensure that the ASN or company name represented makes sense for your organization. If the user is using a foreign IPv6 service, consider reprovisioning the user to your own IPv6 service.

624 - 6to4

Example results:

Help desk code: 624

6to4

IPv4: Good, AS65536, CableCo

IPv6: Good, 6to4, Preferred

IPv4 address: 192.0.2.1

IPv6 address: 2001:db8::1

Interpretation: “6to4” was used to provide an IPv6 address; and the host was configured to actively take advantage of this service. Any web site that has an IPv6 presence, will be reached using 6to4 instead of native IPv4. Modern operating systems do not prefer these kinds of

tunnels by default. Be aware that the user might have a very old operating system or a non-default configuration.

Action: Have the user disable any automatic tunneling mechanisms that are active. 6to4 is a protocol that runs on the PC and tries to get IPv6 traffic through a public relay, using IPv4 as a temporary transport device. Public 6to4 relays offer no SLA; and published studies show approximately 15% failure rates.

Windows: Disable tunnel interfaces using <http://support.microsoft.com/kb/929852> (for example, Microsoft Fix it 50412).

If IPv6 is desired, configure IPv6 and test again. Verify the user has an IPv6 address, and a default route.

64 - NAT64

Example results:

Help desk code: 64

NAT64

IPv4: Good, AS65536, CableCo

IPv6: Good, AS65536, CableCo

OtherSites: 40/40 good

IPv4 address: 192.0.2.1

IPv6 address: 2001:db8::1

Interpretation: IPv6 is working great; IPv4 works only with “named” connections and web sites. Connections by raw IPv4 address fail. This is probably not an error condition; but is explicitly called out in case of support issues with specific IPv4 applications.

Action: Typically, none. If you need IPv4 to work, and your organization has deployed 464xlat, you may need to ensure that your customer has properly configured their device for your 464xlat service. With a working 464xlat, your customer should instead see a help desk code of “46” (IPv4 + IPv6).

64t - NAT64, possible tunnel

Example results:

Help desk code: 64t
NAT64, possible tunnel

IPv4: Good, AS65536, CableCo
IPv6: Good, AS64511, AnotherCo
OtherSites: 40/40 good

IPv4 address: 192.0.2.1
IPv6 address: 2001:db8::1

Interpretation: IPv6 is working great; IPv4 works only with “named” connections and web sites. Connections by raw IPv4 address fail. This is probably not an error condition; but is explicitly called out in case of support issues with specific IPv4 applications.

Action: Typically, none. If you need IPv4 to work, and your organization has deployed 464xlat, you may need to ensure that your customer has properly configured their device for your 464xlat service. With a working 464xat, your customer should instead see a help desk code of “46” (IPv4 + IPv6).

Interpretation (2): The IPv6 connectivity appears to be announced by a different entity (or at least, a different BGP ASN) than IPv4.

Action: Ask the user to read the IPv4 and IPv6 lines; ensure that the ASN or company name represented makes sense for your organization. If the user is using a foreign IPv6 service, consider reprovisioning the user to your own IPv6 service.

6 - IPv6 only

Example results:

Help desk code: 6
IPv6 only

IPv4: no
IPv6: Good, AS65536, CableCo

IPv6 address: 2001:db8::1

Interpretation: Only IPv6 found.

Action: Refer to the IPv4 helpdesk, IPv6 is working perfectly.

Note: IPv6 only users do not trigger the “OtherSites” check. Without IPv4, there is no way to know whether to report an IPv6 reachability problem, or to ignore it (due to site down).

Note: IPv6-only users will need to use “<http://ipv6.test-ipv6.com/helpdesk>” or “<http://ipv6.test-ipv6.com/isp>”.

“slow”

Example results:

Help desk code: 46,slow
IPv4 + IPv6, slow

IPv4: SLOW, AS1234, CableCo
IPv6: SLOW, AS1234, CableCo
OtherSites: 40/40 good

IPv4 address: 192.0.2.1
IPv6 address: 2001:db8::1

Interpretation: IPv4 or IPv6 connections for very short requests to the test-ipv6.com site took over 5 seconds.

Action: Follow standard procedures and scripts to determine whether there's a physical connectivity problem or other standard complication. If only IPv6 is slow; if the user is using a tunnel, suggest they change their tunnel to a closer location.

“mtu” - “Possible MTU issues” Warning

Example results:

Help desk code: 46
IPv4 + IPv6

IPv4: SLOW, AS1234, CableCo
IPv6: SLOW, AS1234, CableCo
WARNING: POSSIBLE MTU ISSUE (in RED)
OtherSites: 40/40 good

IPv4 address: 192.0.2.1
IPv6 address: 2001:db8::1

Interpretation: IPv6 MTU issues are typically caused by ICMPv6 filtering at some point along the path. Small requests were fast; large requests were slow (and/or timed out). There are too many possible solutions to be checked.

Action: This issue requires deeper understanding of IPv6 protocol and solving of this issue depends on how your helpdesk is organized. If you have two or three-tier helpdesk, hand it over to second level support with clearly noting that there are MTU issues. If you have just one-tier helpdesk, hand it over to appropriate escalation department/contact, depending on your escalation policy.

Action: MTU issues are most often caused when Path MTU Discovery (PMTUD) [RFC1981] fails.

1. Check firewall configuration on user's CPE, look for the blocking of ICMPv6 (specifically type "2") either explicitly configured, or implicitly established through lack of rules permitting this.
2. Check for ICMPv6 filtering on the user's path through your access and core network
3. Follow your escalation procedure when needed
Educate your self and your helpdesk team on IPv6.
There are several outstanding resources available to folks new to IPv6:
 - Internet Society Deploy360 - <http://www.internetsociety.org/deploy360/ipv6/>
 - <http://www.networkworld.com/community/blog/mtu-size-issues>
 - http://en.wikipedia.org/wiki/Maximum_transmission_unit

“Site(s) with failed connectivity” Warning

Example results:

Help desk code: 46
IPv4 + IPv6

IPv4: Good, AS1234, CableCo
IPv6: Good, AS1234, CableCo
OtherSites: 39/40 good, 1/40 bad

IPv4 address: 192.0.2.1
IPv6 address: 2001:db8::1

Site(s) with failed connectivity (in RED)
test-ipv6.example.com

http://ipv6.test-ipv6.example.com/images-nc/knob_valid_green.png

Interpretation: One or more sites are unreachable by the user only when using IPv6.

Action: Ensure the user is using your network services. If this error condition persists; or can be confirmed, engage your network routing team to look into it.

6. IPv6 training for helpdesk

IPv6 training for helpdesks is available from many IPv6 training companies all around the world or can be tailored to suit the needs from their basic IPv6 training for engineers and technical staff. When you are rolling out IPv6 in production you need to train all your staff to equalize the IPv4 and IPv6 knowledge anyway, so talk to your training agency and ask them to adapt their IPv6 education program and train your helpdesk team.

7. Conclusion

Most connectivity problems are NOT IPv6 related at all.

Use <http://isp.test-ipv6.com/> for automated IPv6 troubleshooting.

Educate yourself and your helpdesk team on IPv6.

Feedback on this document should be sent to Jan Žorž at zorz@isoc.org.

8. Operator's specifics

What your helpdesk should also know and is specific to your company (operator)